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PATENT SPECIFICATION 1,126,842

DRAWINGS ATTACHED.

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1,126,842

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Int. Cl.:—F 16 l 11/08.

COMPLETE SPECIFICATION.

Flexible Drive Casing Construction and Manufacture Thereof.

We, MERIT PLASTICS, INC., (formerly Merit Molded Plastics, Inc.,) of 400 West Nassau Street, East Canton, Stark County, Ohio, United States of America, a Corporation of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to flexible drives and more particularly to the manufacture and construction of casings for flexible drive cables such as a casing for a power transmission drive for the speedometer of a motor vehicle.

A typical flexible drive for the speedometer includes a flexible power transmitting core wire movable within a flexible casing. The flexible core wire ordinarily comprises an extended helical spring-like member having coupling means at each end for connection with the speedometer and the speedometer drive source. In operation, the core wire drive cable is housed in a casing ordinarily including a plastic inner liner tube within which the core wire rotates. A flexible metal sheath is slipped over the inner liner tube, and the sheath ordinarily is formed by a spirally-wrapped metal strip of special cross section. Sometimes a plastic cover tube is slipped over the flexible spirally-wrapped metal sheath. Thus, such casings have loose inner liner and cover tubes to permit the assembly of these casing components with the spiral metal sheath.

Also, at times the inner plastic tube is omitted. A lubricant is applied to the core wire between the core wire and inner liner or between the core wire and flexible spirally-wrapped metal sheath if the inner liner is omitted.

Such prior drive cable casing constructions present numerous difficulties, disadvantages and defects in manufacture and use. Thus, the inner plastic liner if used, the plastic cover tube and the flexible spirally-wrapped metal sheath are fabricated separately and are then assembled presenting assembly problems which are somewhat difficult and expensive. After assembly, the end fittings for the casing must be secured thereto which usually involves metal-to-metal contact between the fittings and the metal sheath and an inability to provide moisture-tight seals at the connection between the fittings and casing. As a result, moisture inevitably reaches and may attack the core wire. Further, the metal-to-metal joints between the fittings and casing provide favorable conditions for transmitting noise or sound incident to vibration or whipping of the drive cable in operation.

A further and major difficulty encountered in the use of the described prior construction is the resultant effect of kinking the casing. When the flexible spirally-wrapped metal sheath component of the casing is kinked by bending the casing too sharply, either in routing the casing from place to place during installation in a vehicle, or when vehicle repairs are being performed, or from other causes, the kinked portion of the metal sheath does not return to its original shape. This ordinarily, ultimately causes core wire failure at the kink location.

Furthermore, unless a lubricant is uniformly applied to and maintained during use of the core wire, and unless a moisture-tight seal can be maintained at the fittings to

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prevent moisture from reaching core wire surfaces within the casing, dry spots on the core wire ultimately occur which create noise and wear to the core wire. Such noise is objectionable and the wear may in some instances result in failure of the core wire.

According to one feature of the present invention an integrated, flexible, casing construction for flexible drive cables comprises an inner, tubular liner member formed of a lubricant impregnated elastomeric or thermoplastic, plastic material, an outer, tubular, cover member formed of an elastomeric or thermoplastic, plastic material; a tubular, braided, metal wire strand reinforcing sheath within the cover member and surrounding the inner member; and portions at least of the strands of the braided sheath being partially embedded in the liner member plastic material and in the cover member plastic material, whereby the integrated casing is kink-resistant and returns substantially to original shape after relief from kinking forces to which it may be subjected.

According to another feature of the present invention a method of making integrated, flexible, kink-resistant, tubular casings for flexible drive cables includes the steps of continuously forming a tubular inner liner member of an elastomeric or thermoplastic, lubricant-impregnated, plastic material composition; continuously braiding a tubular, braided, metal wire, reinforcing sheath exteriorly around the tubular inner liner member; tensioning the braiding wire while braiding to at least embed portions of such wire in the exterior surface of the inner liner member; and continuously extruding an elastomeric or thermoplastic, plastic material composition to form a tubular cover member around the braided wire reinforced inner liner member under pressure sufficient to embed portions of the braided wire at least partially in the inner surface of the cover member, whereby the thus-formed, integrated casing is kink-resistant and returns substantially to original shape after relief from kinking forces to which it may be subjected.

The integration of the components of the casing construction eliminates the difficulties previously encountered with prior casings having a loose inner sleeve and a loose outer cover assembled to the spirally-wrapped metal sheath. Furthermore, the integrated casing construction can be cut to any desired length and end fittings secured thereto clamped over the outer surface of the outer plastic member producing a moisture-tight seal which prevents moisture from reaching the interior of the casing.

Typical fittings can be formed of either metal or plastic material and when such fittings are secured to the casing construction, metal-to-plastic or plastic-to-plastic joints or seals are produced which act to dampen or lower the sound level of sound imparted to or transmitted along the casing.

The composition and dimensions of the inner and outer plastic members, and the wire size, temper and weave of the braided wire component may be altered to achieve a large range of physical properties, that is flexibility, crush-strength, etc., for the integrated casing.

Furthermore, an integrated casing construction according to the present invention can afford uniform flexibility in every direction and provide a casing that will not kink easily. The references to kinks and kinking herein relate to a deformation of the inner tubular member to such a degree that adequate clearance is absent for operation of the contained core wire after relief of the kinking force. From this standpoint, the casing substantially returns to original shape after kinking, at least to a degree such that a contained core wire can operate without failure due to the kinking.

As a result, the resistance to kinking and the return to original shape when kinked, which characterize an integrated casing construction embodying the present invention can eliminate the cause of core wire failure which is the inevitable result of kinking of prior flexible metal sheath casing construction. The inherent flexibility and uniformity of flexing along the length of an integrated casing embodying the present invention when bent in any direction, in addition to resisting kinking and returning to original shape when kinked, provide additional flexibility for the casing, so that routing of the casing with the core wire assembled therein is much easier in installing the casing in cars and trucks.

The enhanced and uniform flexibility of an integrated casing construction according to the present invention, as compared with prior metal sheathed casings which are stiffer and do not return to shape when kinked, allow the core wire to rotate within the casing without whipping that when present causes needle movement of a speedometer indicator. That is to say, the flexibility of the integrated casing takes up or absorbs any core wire whipping which tends to occur so that the same is not transmitted to or does not cause improper movement of the driven member such as the speedometer indicator.

The provision of a lubricant-impregnated plastic inner liner component for the integrated casing can achieve several objectives. First, uniform lubrication and elimination of dry spots throughout the length and breadth of the casing, can be obtained for the core wire. Second, the lubricant-impregnated inner liner can continue to provide lubrication throughout the life of the casing. Third, the necessity of applying a special lubricant to

the core wire when assembling the core wire in the casing and of uniformly covering the core wire with such special lubricant can be eliminated. Although no lubricant is required in assembling and operating a core wire in an integrated casing according to the present invention, a light oil may be used in assembly if desired. The elimination of dry spots by the use of the lubricant-impregnated inner liner can in turn eliminate noise and wear which may cause ultimate failure of the core wire in use.

The invention will be further described by way of example, with reference to the accompanying drawings wherein:

Figure 1 is a perspective view of the improved integrated flexible casing construction;

Fig. 2 is an exploded perspective view of fragmentary portions of the components of the improved integrated casing construction;

Fig. 3 is a view similar to Fig. 2 illustrating the improved integrated construction;

Fig. 4 is a view similar to Fig. 3 but showing an helical spring-type drive cable core wire assembled in the improved casing;

Fig. 5 is a view similar to Fig. 4 but showing a push-pull drive member core wire assembled in the improved casing;

Fig. 6 is a side elevation with parts broken away and in section of the terminal ends of a length of improved casing with end fittings secured thereto providing moisture-tight seals; and

Fig. 7 is an enlarged fragmentary sectional view taken on the line 7—7, Fig. 3 illustrating the manner in which the braided wire reinforcing sheath is embedded in the inner and cover members.

Similar numerals refer to similar parts throughout the various figures of the drawing.

The improved integrated flexible casing construction is indicated generally at 1 and includes an inner plastic liner member or lamination 2, an outer tubular plastic cover member or lamination 3, and an intervening braided wire reinforcing sheath 4 imbedded at least partially in each of the liner and cover laminations substantially throughout the length of the sheath, as shown.

In accordance with the invention, the inner, plastic, tubular liner member 2 is lubricant-impregnated, and may be formed of an elastomeric or thermoplastic, plastic material such as nylon, linear polyethylene, polypropylene, vinyl resin, acetal resin or polyurethane. These materials may be compounded so that with a selected wall thickness for the tubular member 2, the desired flexibility and crush-strength can be obtained. The lubricant with which the plastic material of member 2 may be impregnated may be graphite or molydisulphide. The lubricant may be mixed with the thermoplastic material in powdered form before molding or extruding the tubular member 2 under the required conditions of heat and pressure.

The plastic, lubricant-impregnated, inner liner member 2 is preferably continuously extruded in the usual manner from the desired plastic-lubricant composition, thereby necessarily resulting in the single lamination liner as shown.

The braided wire sheath 4 is then continuously braided telescoped over and around the liner member 2 with sufficient tension that the wire components are at least partially embedded in the outer surface of the member 2 as indicated by the broken lines 5 in the drawing.

The braided wire sheath 4 may be a one-end, a two-end or a multiple-end braided wire, depending upon the degree of strength desired, and the braiding operation may be carried out on a typical braiding machine, either as a separate operation, or in a continuous production line of equipment immediately following the extruder for the inner liner 2, in any case resulting in the single layer open mesh braided sheath as shown.

The liner 2 with the braided wire sheath 4 thereon is then covered with the plastic cover 3. The cover 3 may be formed of any of the elastomeric or thermoplastic, plastic materials indicated as suitable for the inner liner, omitting the lubricant which is not required in the cover material. The cover 3, like the inner liner 2, may be continuously extruded in the usual manner under the required conditions of heat and pressure, telescoped over and around the sheath reinforced inner liner 2 in an extruder, either as a separate operation, or in the continuous production line immediately following the braiding machine, thereby necessarily resulting in the single lamination cover as shown. Sufficient pressure is exerted in forming the cover 3 that the metal wire components of the braided wire sheath 4 are at least partially embedded in the inner surface of the cover 3 as indicated by the broken lines 6 (Fig. 2) of the drawing.

The compounding of the plastic material from which the cover member 3 is formed as well as the wall thickness thereof may be selected to obtain the desired degree of flexibility. Thus, the casing 1 may have any combination of physical properties desired for any particular application or use.

The braided wire sheath 4 has the inherent capacity of bending about a uniform radius whenever bent from any angle. This characteristic along with the characteristics of the thermoplastic materials from which the liner 2 and cover 3 are formed, to return to original shape, when bent, combine to provide a casing 1 which resists kinking when bent sharply and which does not take a permanent kink-set but returns substantially to original shape preventing failure from kinking of any core wire contained within the casing 1.

The integrated, flexible casing construction 1 continuously formed in the manner described may be cut to the required length for any desired use and coupling or fitting members 7 may be secured to the ends of a cut length as indicated in Fig. 6. The fittings 7 may be formed of metal or plastic material with a sleeve portion 8 shouldered at 9 telescoped over the end portion of the casing 1. The sleeve portion 8 of the fitting 7 is crimped or beaded inward as indicated at 10 to form an inwardly projecting annular rib 11 compressed inward into the plastic cover member 3 forming a moisture-tight seal between the fitting and the casing.

Where the fittings 7 are formed of metal, a metal-to-plastic joint is formed between the fittings 7 and casing 1 which acts to dampen the transmission of sound, or lower the sound level of any sound transmitted, to or through the casing. If the fittings 7 are formed of plastic material, the crimped joint between the fittings 7 and casing 1 may be a heat-sealed or fused joint. With plastic fittings 7, a plastic-to-plastic joint is formed between the fittings 7 and casing 1 which similarly dampens any transmission of sound through the casing or fittings.

The flexible casing 1 produced in the manner described has a resultant integral or integrated unitary construction comprising the inner plastic lubricant-impregnated liner 2, the outer plastic cover 3 and the intervening braided wire reinforcing sheath 4 embedded partially in the liner 2 and cover 3. This integrated casing 1 in use can be bent uniformly around extremely sharp radii in any direction witiout kinking, so that the casing may be very readily routed through assembly paths in a motor vehicle or other device in which the casing is used. Although the casing 1 resists a tendency to kink, if it is subjected to an extreme force producing kinking, it will return to shape after the kinking force has been removed. Thus, no permanent kinks result to such degree as can cause, failure of a core wire passing through the casing.

A core wire drive cable 12 (Figs. 4 and 6) may be passed through a section of the casing 1 either before or after the fittings 7 are assembled to the ends of a casing section. The core wire drive cable may be either a typical helical spring-like member 12 as illustrated which rotates to transmit a drive; or the core wire may be a solid flexible wire 13 of the push-pull type illustrated in Fig. 5. In either event, substantially friction-free movement of the core wire 12 or 13 within the casing with minimum noise and wear can occur, because of the lubrication of the surfaces of the core wire 11 or 12 which contact with the interior of the liner 2, by the lubricant present in the inner liner 2.

The inherent flexibility of the plastic materials from which the liner 2 and cover 3 are formed provides casing flexibility allowing the core wire 12 to rotate within the casing without whipping. Such whipping frequently causes improper needle movement of a speedometer indicator if present.

The casing construction may be used for the flexible drives for devices other than speedometers, such as in a flexible drive extending to or along the boom of a power shovel or crane.

WHAT WE CLAIM IS:—

1. Integrated, flexible, casing construction for flexible drive cables comprising an inner, tubular, liner member formed of a lubricant impregnated elastomeric or thermoplastic, plastic material; an outer, tubular, cover member formed of an elastomeric or thermoplastic, plastic material; a tubular, braided, metal wire strand reinforcing sheath within the cover member and surrounding the inner member; and portions at least of the strands of the braided sheath being partially embedded in the liner member plastic material and in the cover member plastic material, whereby the integrated casing is kink-resistant and returns substantially to original shape after relief from kinking forces to which it may be subjected.

2. Integrated, flexible, casing construction for flexible drive cables comprising a single inner, tubular, lubricant-impregnated liner lamination formed of an elastomeric or thermoplastic, plastic material; an outer, tubular, cover lamination telescoped over the liner lamination and formed of an elastomeric or thermoplastic, plastic material; a single layer tubular open mesh braided metal wire reinforcing sheath telescoped within the cover lamination and telescoped over and surrounding the liner lamination; and portions at least of the wires of the braided wire sheath being partially embedded in the liner lamination plastic material and cover lamination plastic material substantially throughout the length of the braided wire sheath, whereby the integrated casing is kink-resistant and returns substantially to original shape after relief from kinking forces to which it may be subjected.

3. The method of making integrated, flexible, kink-resistant, tubular casings for flexible drive cables including the steps of continuously forming a tubular inner liner member of an elastomeric or thermoplastic, lubricant-impregnated, plastic material composition; continuously braiding a tubular, braided, metal wire, reinforcing sheath exteriorly around the tubular inner liner member; tensioning the braiding wire while braiding to at least partially embed portions of such wire in the exterior surface of the inner liner member; and continuously extruding an elastomeric or thermoplastic,

plastic material composition to form a tubular cover member around the braided wire reinforced inner liner member under pressure sufficient to imbed portions of the braided wire at least partially in the inner surface of the cover member, whereby the thus-formed, integrated casing is kink-resistant and returns substantially to original shape after relief from kinking forces to which it may be subjected.

4. An integrated, flexible casing construction for flexible drive cables, constructed, arranged and adapted for use substantially as herein described with reference to and as illustrated in the accompanying drawings.

5. An integrated, flexible casing construction for flexible drive cables when made according to the method claimed in claim 3.

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Chartered Patent Agents.

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Fig. 1

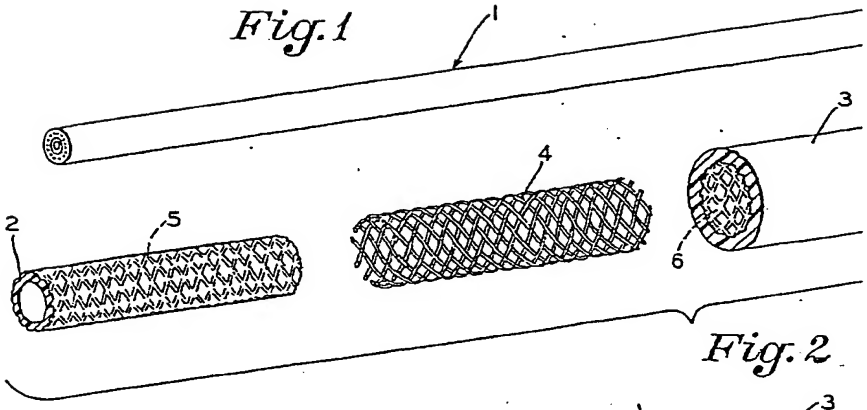


Fig. 2

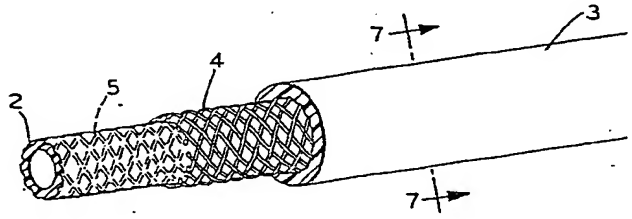


Fig. 3

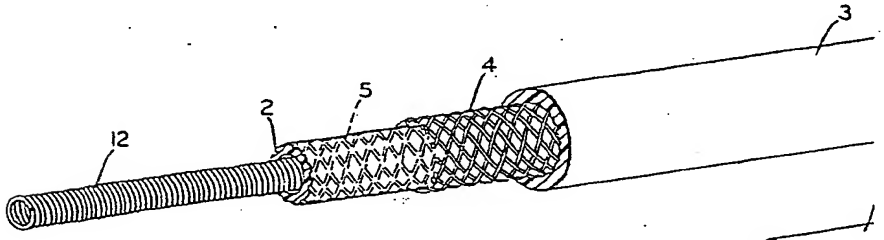
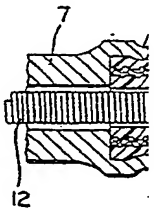


Fig. 4



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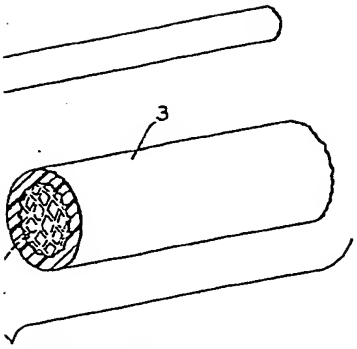
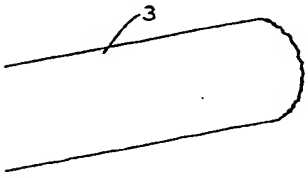


Fig. 2



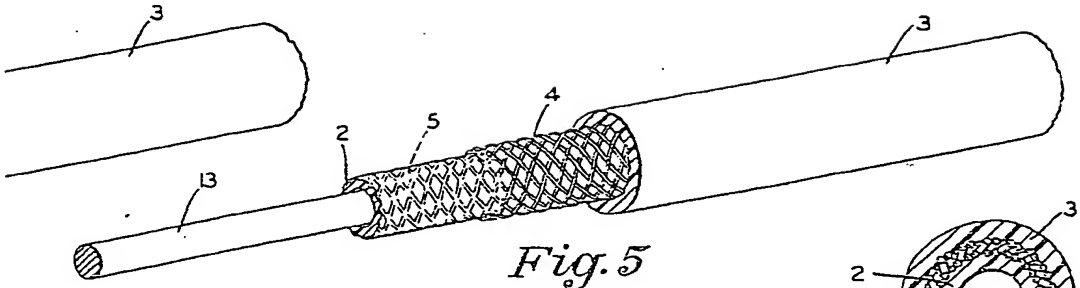


Fig. 5

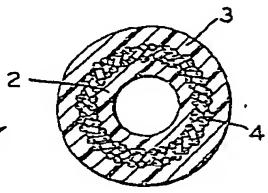


Fig. 7

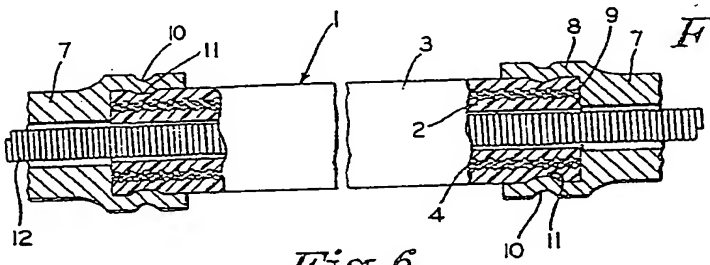


Fig. 6

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Fig. 1

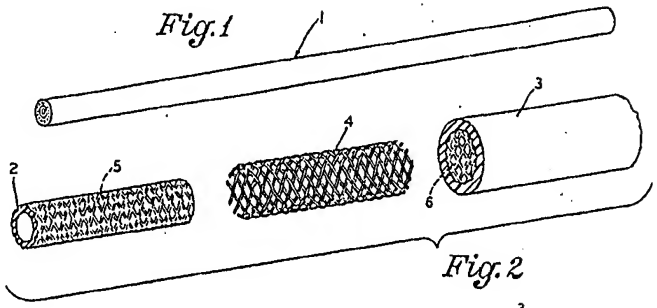

Fig. 2

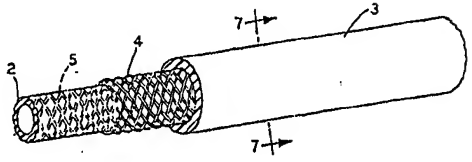

Fig. 3

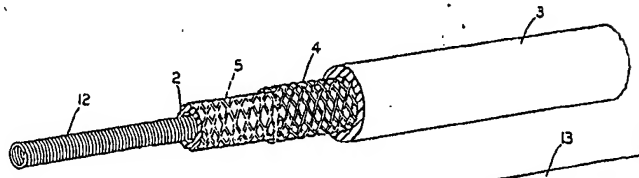

Fig. 4

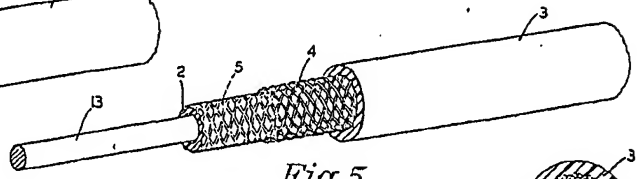

Fig. 5

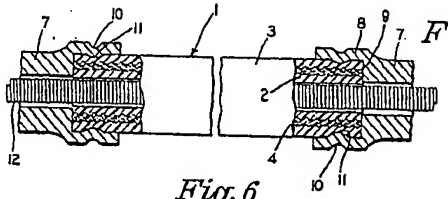

Fig. 6

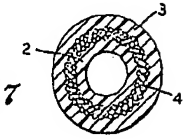

Fig. 7